

CLIMATE CHANGE, ENERGY AND ENVIRONMENT

ENSURING RESILIENCE OF AGRICULTURE TO CLIMATE CHANGE

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The global trend of climate change has also been observed in the Republic of Moldova. In the last two decades, there has been an increase both in the average annual temperature and in the frequency of extreme weather events.



Amid intensifying climate change, environmental issues have become a serious constraint on the country's social and economic development. The economic sector most affected by the negative effects of climate change is agriculture.



The Moldovan government has permanently paid insignificant attention to environmental protection. This is one of the reasons for the country's low capacity to adapt to climate change.

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INTRODUCTION

The Republic of Moldova is extremely vulnerable to climate variability. Extreme climate events (droughts, frosts, hail, floods) have become frequent in the Republic of Moldova, this being a clear effect of the global climate change. At the same time, the environmental management of the state at the country level has been poor. This has only contributed to the aggravation of ecological problems. Sharp climate change has already become a constraint on the country's economic growth, the main sector to suffer from it being the agriculture. The 2020 drought is an eloquent example of this. Also in relation to this crisis the government has not shown any vision or taken firm actions. In this context, this analysis aims at understanding how the changing climate conditions are affecting the dynamics of agriculture and at making recommendations on ensuring the resilience of the sector. The analysis confirms the conclusions of the State of the Country Report 2020 and underlines the importance of paying an increased attention to strengthening the immunity of the Republic of Moldova to climate vulnerabilities.

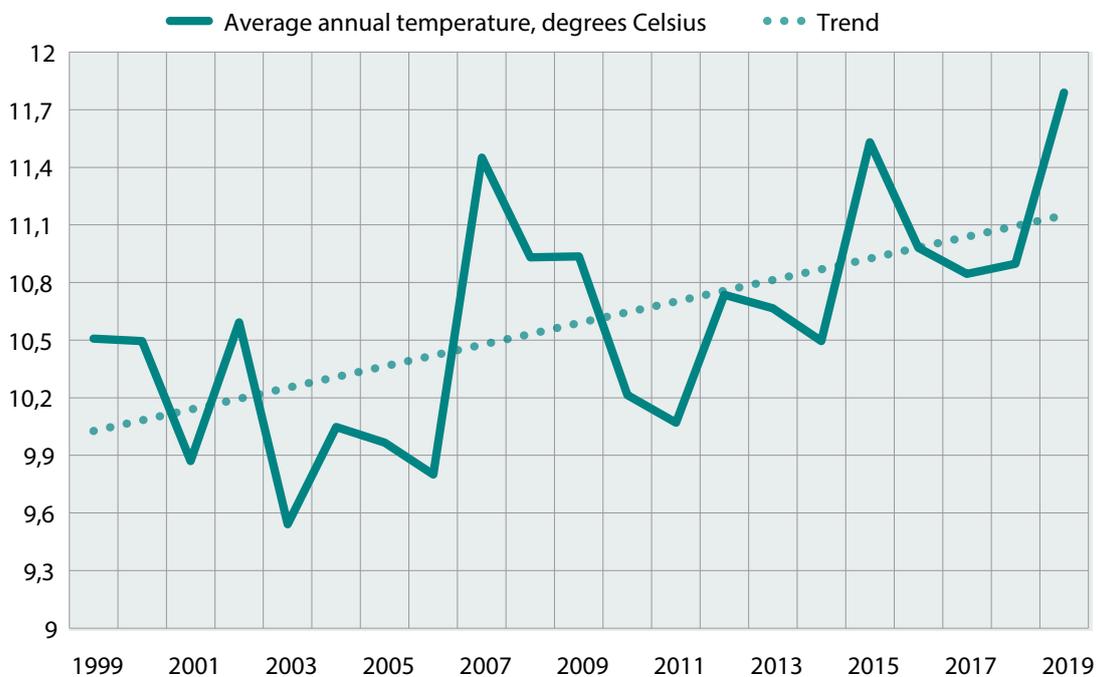
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HOW CLIMATIC CONDITIONS HAVE EVOLVED IN REPUBLIC OF MOLDOVA

The intensification of climate change, characterized, in particular, by rising temperatures, is a global trend. In the Republic of Moldova, the records from the last two decades (1999-2019) show a clear increase in the average annual temperature by one degree Celsius. This development is characteristic for all regions of the country. Thus, in the entire country, in 2017-2019, the average annual temperature increased from 10.3 to 11.2 degrees Celsius compared to

1999-2001. At the regional level, the following increases have been attested: from 9,2 to 10 degrees Celsius in the north of the country, from 10.8 to 11.5 degrees Celsius in the centre and from 10.9 to 12 degrees Celsius in the south. Also the regression that describes the temperature trend over time reveals that the average temperature in the Republic of Moldova increases annually by about 0.06 degrees Celsius (Figure 1).

Figure 1.
Evolution of the average annual temperature, degrees Celsius

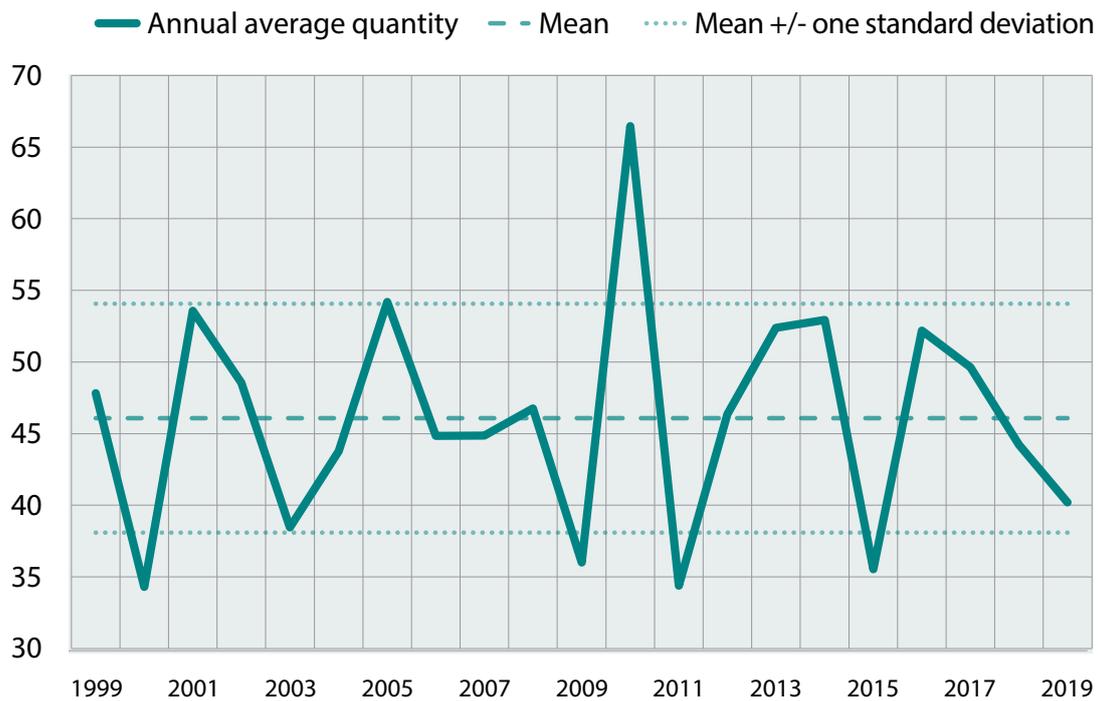


Source: NBS, State Hydrometeorological Service, Expert-Grup calculations

In the case of precipitation, there is no clear trend, but its fluctuation is high. Between 1999 and 2020, the average annual volume of precipitation was 46.1 mm, and the standard deviation was about 8 mm, which determined a coefficient of variation of about 17.3 per cent. (Figure 2). The largest oscillations of precipitation have been attested in the southern and northern regions of the country. In the south, the amount of precipitation has reached an average of 42.4 mm, with a

standard deviation of 10.3 mm and a coefficient of variation of 24.3 per cent. In the north, the average annual amount of precipitation was 50.8 mm, the standard deviation being 11.2 mm, which resulted in a coefficient of variation of about 22 per cent. A lower level of precipitation variability has been registered in the centre of the country, where the coefficient of variation has reached the level of 17.1 per cent due to an average of 45 mm and a standard deviation of 7.7 mm.

Figure 2.
Evolution of the annual amount of precipitation



Source: NBS, State Hydrometeorological Service, Expert-Grup calculations

At the same time, the climate change in the Republic of Moldova is characterized by an increased number of extreme weather events. Thus, in the last twenty years, there have been several droughts of varying intensity, the most severe ones taking place in 2003, 2007, 2012, 2015

and 2020. Also, floods often occur, three of the strongest happening in 2006, 2008 and 2010. In the context of extreme weather events, there should be mentioned the severe frosts and heavy snow of April 2017.

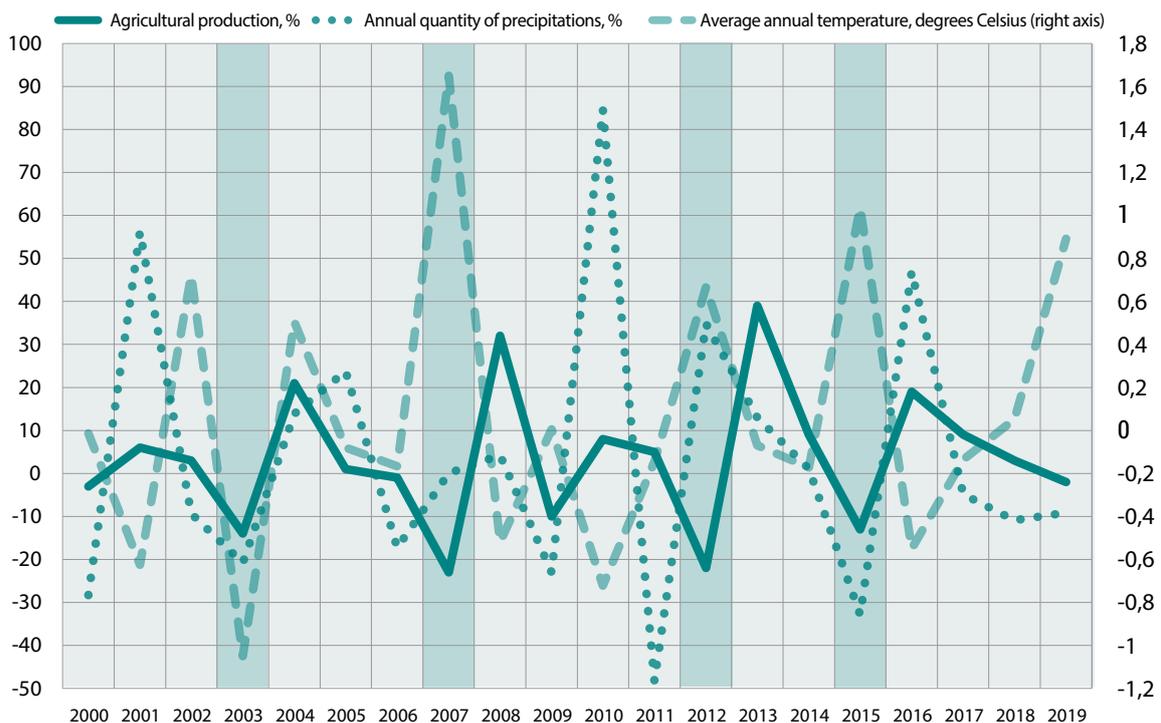
2

HOW AGRICULTURE IS AFFECTED BY CLIMATE CHANGE

Climate change is influencing the economy through various channels, but the fastest and most visible effect on the economy is through agriculture. Moreover, econometric estimates confirm this hypothesis and reveal a statistically significant relationship between the dynamics of precipitation and temperature, on the one hand, and the volume of production in the agricultural sector, on the other hand. The model was made based on annual observations covering the period 1999-2019 and has as variables the agricultural production, expressed in constant prices in 2010, the average annual temperature and the volume of rainfall. Based on the model, a robust statistical link has been found between the dynamics of annual changes in climate variables (temperature and precipitation level) and the agricultural produc-

tion (Annex 1). There is a non-linear relationship between the temperature evolution and the agricultural dynamics. Thus, if we assume that other influencing factors (e.g. precipitation) have not changed over time, the increase in average annual temperature by more than 0.66 degrees Celsius leads to a decrease in the agricultural production by about 0.12 per cent. The decrease in the annual temperature with values higher than 0.66 degrees causes unfavourable developments in the agricultural sector. The change in temperature with values between -0.66 and 0.66 degrees Celsius, has a marginal positive impact on agriculture. Increasing the amount of rainfall by 1 per cent leads to an increase in the agricultural production by about 0.19 per cent. The volume of precipitation in the previous year can be considered as a variable that indicates the

Figure 3.
Annual change in the volume of agricultural production, the amount of precipitation and the average temperature



Source: NBS, State Hydrometeorological Service, Expert-Grup calculations

amount of moisture in the soil. The increase in the amount of precipitation in the previous year by one percent determines the increase of agricultural production by about 0.26 per cent.

Usually, the most severe droughts are accompanied by a decline in the agricultural sector by at least 10 per cent. In 2003, the agricultural production decreased by 14 per cent, while the volume of precipitation decreased by 9.4 per cent in 2002 and by 20.8 per cent in 2003 (Figure 3). In 2007, the contraction of the agricultural sector by 23 per cent was determined by the increase in the average annual temperature by about 1.7 degrees Celsius and the decrease of the previous year's precipitation by 17.3 per cent. In 2012, agriculture shrank by 22 per cent, a result close to the 2007 decline. The

decline in 2012 was caused by the increase in the average annual temperature by 0.7 degrees Celsius and the reduction of rainfall in the previous year by 48.3 per cent. The decrease in production in 2015 accounted for 13 per cent and was caused by the increase in temperature by 1 degree Celsius and the decrease in precipitation by 32.9 per cent. The year 2020 will also be marked by a sharp reduction in agricultural production. In the first 9 months of 2020, the sector contracted by ¼ y-o-y. One of the causes of this evolution was the particularly hot winter. Thus, the winter of 2019-2020 was characterized by temperatures of 3-4 degrees Celsius higher than normal, and the amount of precipitation was reduced.¹ The thermal regime specific to the winter of 2019-2020 is similar to the 2006-2007 season.²

¹ <http://old.meteo.md/newsait/iarna2020.htm>

² Ibidem

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THE QUALITY OF FACTORS ENSURING THE ADAPTATION OF THE REPUBLIC OF MOLDOVA TO THE CLIMATE CHANGE

The Republic of Moldova has “an adaptation deficit” to climate change. This is also due to the fact that the components that could ensure some resilience to climate change, such as water and forest resources, are in a precarious condition. Water is a scarce resource for the Republic of Moldova. Forests account for only 11 per cent of the country’s territory, and this level is below the minimum threshold needed to ensure the ecological balance of 15 per cent.³ Although over 50 per cent of the country’s area is occupied by arable agricultural land⁴, the land fund is exposed to advanced erosion processes. One of the main causes of soil erosion is the low level of afforestation in the country.⁵

The water resources available to the Republic of Moldova are low, while the water consumption is rather high, even though the water capture volume has decreased. The internal resources (rivers and groundwater reserves) are only 1.6 billion m³, which is about 590 m³ per capita. According to the volume of domestic water resources reported per capita, the Republic of Moldova ranks last compared to other European countries. Between 2001 and 2019, the water capture volume decreased from 874 to about 840 million m³. At the same time, the water capture volume per capita represents 315 m³. The ratio between the water capture volume and renewable water resources is about ½, and with

regard to this indicator the Republic of Moldova occupies one of the first positions among European countries, which means that the country is using its few water resources in an unsustainable way, which leads to an intensification of existing risks (Table 1).

One of the causes of intense water capture is the relatively large losses during transportation. In the Republic of Moldova, between 2001 and 2019, the ratio between water losses during transportation and the water capture volume has constantly increased, fluctuating around 7-8 per cent, which represents 60-70 million m³. At the same time, the water loss per capita in the Republic of Moldova is quite high in comparative aspects, accounting for about 23 m³, which places Moldova on the first positions in relation to other European countries (Figure 4).

The water resources available to the Republic of Moldova are of poor quality. In 2019, 56 per cent of the samples taken from the centralized water supply systems and 73 per cent from the decentralized systems did not correspond to the required sanitary-chemical parameters. At the same time, the expansion of the sanitation system was mainly done at the expense of the development of sewerage systems, and the construction of sewage treatment plants has remained insignificant. Between 2016 and 2019, the length of public water distribution networks has increased by about 1402 km, while the length of public sewerage networks has increased by only about 117 km. These developments have caused the volume of polluted water (water without treatment and insufficiently treated) to remain relatively constant after 2005, with variations between 8-10 million m³.

The advanced degradation of the irrigation infrastructure in the first two decades since independence of the Republic of Moldova has been an important cause of the decrease of water consumption in agriculture. However, after 2009, there was a slight increase in water consumption. The lack of investment after 1991 has caused the deterioration of the irrigation system. Thus, currently, about 60 per cent of centralized irrigation sys-

3 Lupuşor A., Fala A., Popa A., Cenuşă D., Morcoţilo I., Prohniţchi V., Republica Moldova 2015. State of the Country Report, Analytical Independent Centre “Expert-Grup”/ Friedrich Ebert Stiftung Moldova, Chisinau, 2015, p. 36

4 Lupuşor A., Fala A., Cenuşă D., Morcoţilo I., Republica Moldova 2014. State of the Country Report, Analytical Independent Centre “Expert-Grup”/ Friedrich-Ebert-Stiftung Moldova, Chisinau, 2015, p. 35

5 “National strategy for agricultural and rural development for the years 2014-2020” approved through the Government Decision 409/2014, https://www.legis.md/cautare/getResults?doc_id=76222&lang=ro

Table 1.
Internal renewable water resources and the water capture volume, 2017

	Internal renewable water resources, billion.m ³	Water capture volume, billion. m ³	Internal renewable water resources per capita, m ³	Water capture volume per capita, m ³	Ratio between the internal renewable water resources and the water capture volume, %
Bulgaria	82,1	5,7	11 560	796,7	6,9
Cech Republic	14,5	1,6	1 371	154,1	11,2
Croatia	187,9	0,7	45 230	162	0,4
Latvia	45,7	0,2	23 417	107,1	0,5
Lithuania	33,8	0,3	11 861	102,4	0,9
Malta	0,07	0,04	150	93,4	62,2
Moldova*	1,6	0,8	588	304,9	51,9
Poland	61,0	10,7	1 608	280,5	17,5
Portugal	17,1	4,8	1 661	469,2	28,3
Romania	29,2	6,8	1 488	344,2	23,1
Slovenia	32,2	0,9	15 578	450	2,9
Slovakia	79,4	0,6	14 598	106,5	0,7
Albania	33,3	1,2	11 560	413,1	3,6
Serbia	151,3	5,4	21 493	763,8	3,6

Source: EUROSTAT, NBS, World Bank, Expert-Grup calculations

Note: for the Republic of Moldova, the latest data on internal renewable water resources date back to 2014

tems need rehabilitation⁶. The degradation of the irrigation system has also determined a drastic reduction of the irrigated area. While in the first years of independence of the Republic of Moldova (1993-1995), the irrigated area represented 100 thousand ha, after 2015, it ranged between 3-4 thousand ha⁷. Thus, after 2000, no more than 1/5 of the

agricultural land was irrigated⁸.

Although there is a certain increase in the afforestation of the country, the Republic of Moldova remains a state with low forest resources. Forested areas in the Republic of Moldova are particularly important for improving the ecological balance, reducing hydrological and wind erosion and improving the productivity of agricultural land.⁹ Between 2010 and

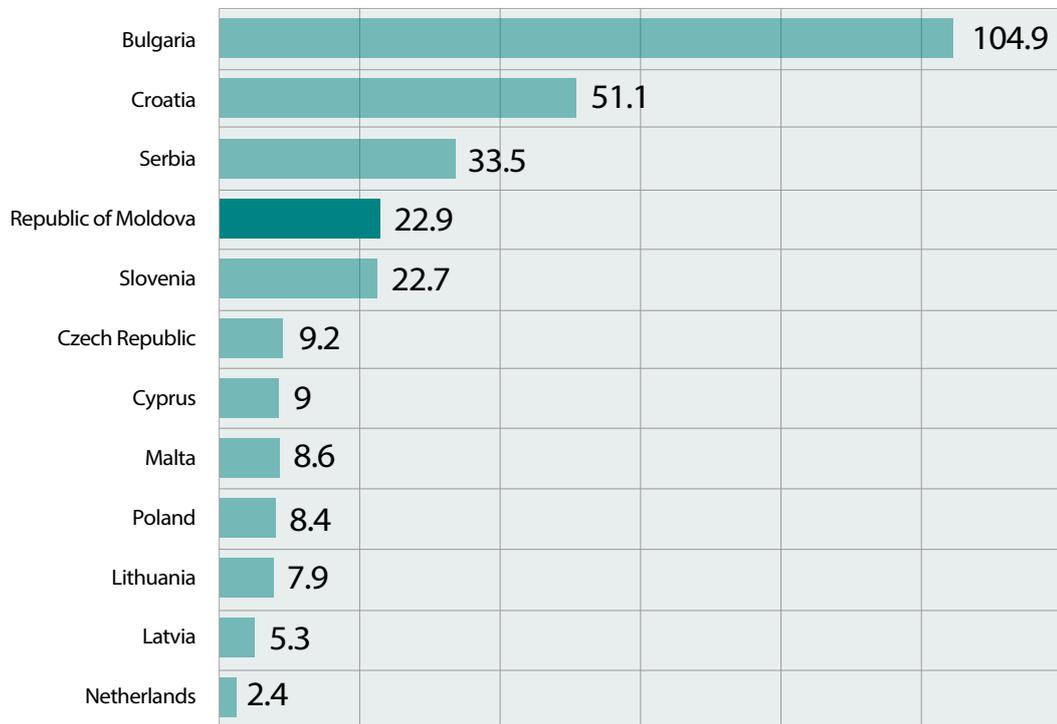
6 "National strategy for agricultural and rural development for 2014-2020" approved through the Government Decision 409/2014, https://www.legis.md/cautare/getResults?doc_id=76222&lang=ro

7 <https://cancelaria.gov.md/sites/default/files/document/attachments/intr254.pdf>

8 "National strategy for agricultural and rural development for the years 2014-2020" approved through the Government Decision 409/2014, https://www.legis.md/cautare/getResults?doc_id=76222&lang=ro

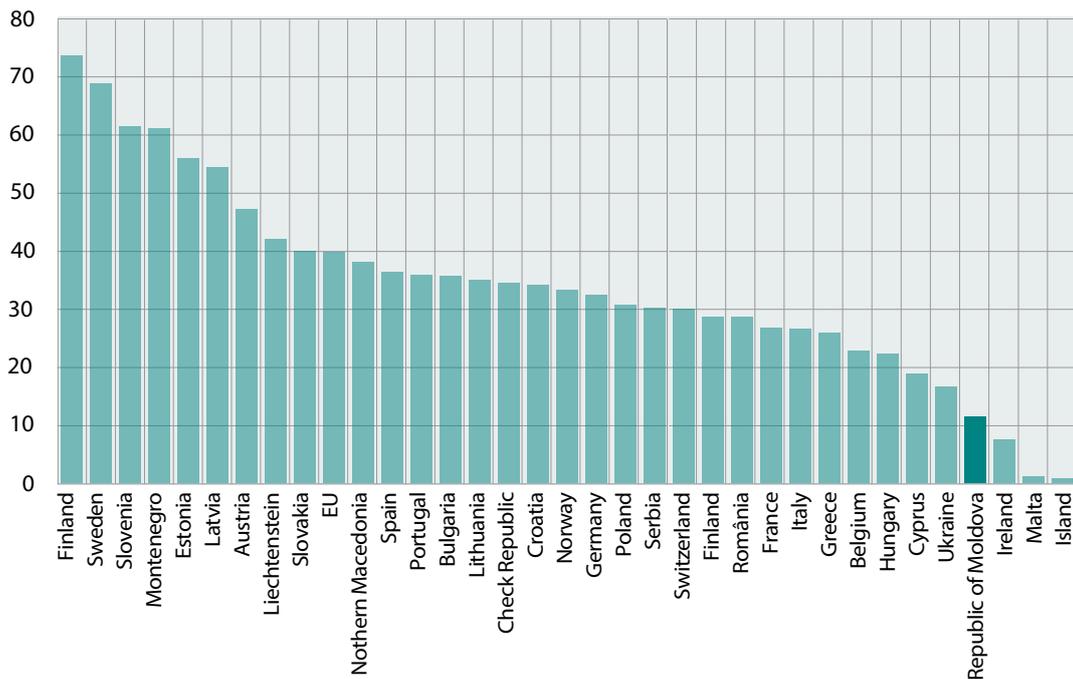
9 *Ibidem*

Figure 4.
Water loss during transportation per capita in 2017, m³³



Source: EUROSTAT, NBS, World Bank, Expert-Grup calculations

Figure 5.
Degree of afforestation, 2019



Source: <https://ourworldindata.org/forests>, NBS

2019, the area of land covered by forests has increased from 375 to 381 thousand ha. Due to these developments, the degree of afforestation of the country has increased from 11.1 to 11.3 per cent. However, it remains low compared to other European countries, with the Republic of Moldova occupying one of the last positions in this sense (Figure 5).

The land fund of the Republic of Moldova is exposed to major risks, and the soils are subject to an advanced degradation process. Republic of Moldova has about 81,000 ha of degraded land, which is impassable for agricultural use¹⁰. At the same time, about 800 thousand ha of land are affected by erosion processes. Low soil quality becomes a critical problem for the country and leads to lower crop productivity¹¹.

¹⁰ <http://www.mediu.gov.md/ro/content/starea-mediului-la-nivel-național>

¹¹ "National strategy for agricultural and rural development for 2014-2020" approved through the Government Decision 409/2014, https://www.legis.md/cautare/getResults?doc_id=76222&lang=ro

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ENVIRONMENTAL POLICIES NECESSARY TO INCREASE THE ADAPTATION TO CLIMATE CHANGE OF THE AGRICULTURAL SECTOR

Republic of Moldova has several policy documents addressing climate change, which expire in 2020. The “National Strategy for Agricultural and Rural Development for 2014-2020” was approved in 2014. One of the general objectives of the Strategy is “Ensuring the sustainable management of natural resources in agriculture”, one of the specific objectives being “Supporting the adaptation and mitigation of the effects of climate change on agricultural production”. In 2014 there was also approved the “Strategy of the Republic of Moldova for adaptation to climate change until 2020”¹². The document identifies six areas: agriculture, water resources, health sector, forest resources, energy sector, transport and road infrastructure which have been identified as having the highest sensitivity to climate change and thus in need of more attention. The strategy has three objectives: (1) creating the institutional framework in the field of climate change, (2) creating a mechanism to monitor the impact of climate change and (3) ensuring the development of climate resilience and facilitating adaptation to climate change in the six priority sectors. The environmental strategy for 2014-2023 also sets targets that contribute to increasing resilience to climate change, such as improving the quality of at least 50 per cent of surface water or expanding the forest area to 15 per cent of the country’s territory. At the same time, other environmental policy documents provide for actions that should contribute to ensuring better adaptation to climate change.

The precarious state of natural resources also indicates the low interest of the state in the ecological situation of the country, which translates into an unsatisfactory implementation of environmental policies. The decrease in budget allocations for environmental protection supports this presumption. While in 2015 the budget expenditures for environmental protection were about MDL 176 million, in 2019, the volume of allocations reduced to MDL 133 million. As a result, the share of public expenditure on environmen-

tal protection relative to GDP fell from 0.12 to 0.06 per cent. At the same time, the international comparisons show that the Republic of Moldova spends too little on the environment. According to the share of budgetary allocations for environmental protection relative to GDP, the Republic of Moldova occupies the last position in Europe (Figure 6). European states grant at least twice as much as our country for improvement of the ecological situation.

The low level of public spending on environmental protection is determined not only by the low interest of the state in this field, but also by the low capacity of institutions to capitalize on allocated sources. For the Republic of Moldova, the situation in which the state is not able to make full use of the budgetary sources that are planned for environmental protection has already become a normality. Moreover, in the 2015 and 2019 period, the ratio between the planned level and the actual value of environmental protection expenditures varied between 45 and 63 per cent.

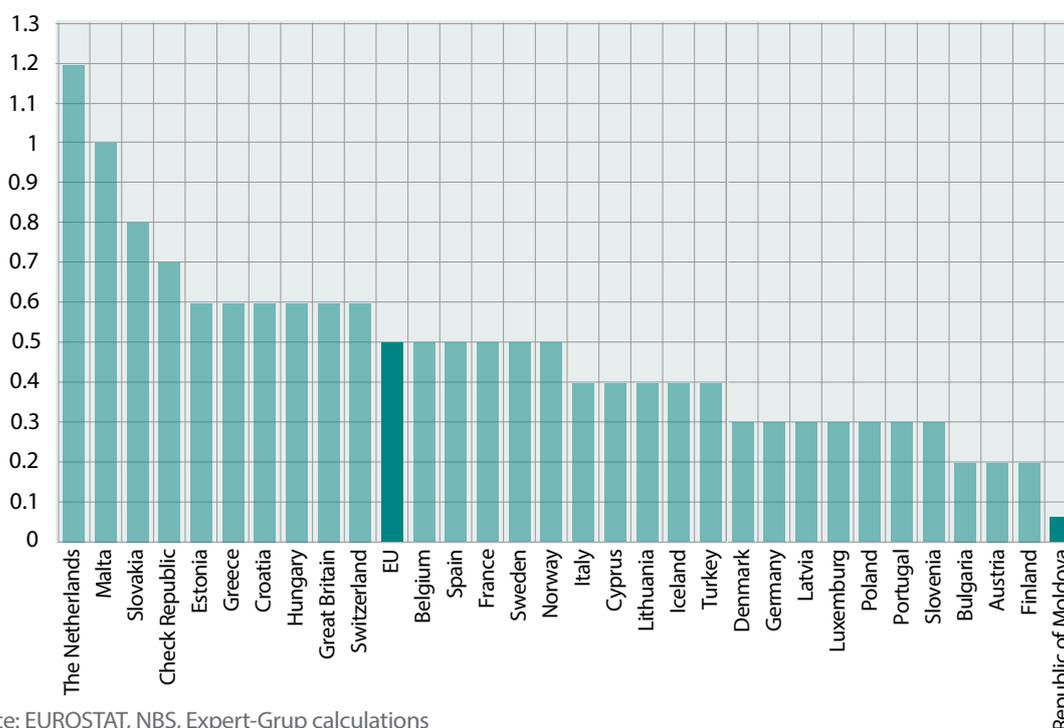
Basically, it must be acknowledged that the climate change has already become an imminent constraint on development of the Republic of Moldova. Insufficient adaptation to climate change is accompanied by worrying dynamics of climatic conditions. Thus, the tendency of the temperature increase is accentuated, and the extreme meteorological phenomena have become a normality, this fact negatively affecting the national economy.

Moldova can no longer ignore environmental issues and is obliged to take urgent measures to increase adaptation to climate change. The effect of neglecting environmental objectives has been increasingly felt by the economy and the country in general¹³. The 2020 drought is an eloquent

¹² “Strategy of the Republic of Moldova for adaptation to climate change until 2020, https://www.legis.md/cautare/getResults?doc_id=49220&lang=ro

¹³ Lupuşor. A., Fala A., Cenuşă D., Morcoţilo I., Madan S., Republic of Moldova 2020. State of the Country Report, Independent Analytical Center “Expert-Grup”/ Friedrich-Ebert-Stiftung Moldova, Chisinau, 2020, p. 3

Figure 6.
Budgetary expenditures for environmental protection in relation to GDP %, 2017



Source: EUROSTAT, NBS, Expert-Grup calculations

example of this¹⁴. Thus, the Republic of Moldova has too little time to follow the strategy of “small steps” to ensure adaptation to climate change.

Although the implementation of large projects in the field of environment requires an increased financial effort, the Republic of Moldova could increase and spend more efficiently the budgetary resources. Even without access to external sources, the state could at least double the amount of allocations to promote environmental policies. This is possible if the capacity of public institutions in assimilating the budgetary sources allocated for environmental protection was increased. In this context, reforms are needed that would strengthen the Environment Agency, the Environment Departments within the Ministry of Agriculture, Regional Development and Environment and other relevant institutions in the field.¹⁵

In order to increase the resilience of agriculture to climate change, a number of measures are needed, paying particular attention to the restoration of natural resources. A first action would be the streamlining of the production process in the agricultural sector to include measures aimed

at stimulating farmers to grow drought-resistant crops and observe the crop technologies.

Another important set of measures refer to the reduction of water scarcity. Increasing water resources is a precondition for rebuilding and expanding the irrigation system. In order to reduce the water deficit, the following actions are necessary:

- Investments in infrastructure to reduce water transport losses;
- Restoration and increase of the number of treatment plants, in order to ensure the return of a large volume of water used in production and consumption;
- Restoration and protection of the internal river basin (rivers, streams and lakes).

Another important direction refers to the afforestation of the country. The degree of afforestation of the country represents 11.3 per cent, and this level is below the minimum threshold necessary to ensure the ecological balance. Thus, in the medium term (3-5 years), the degree of afforestation of the country should be extended to 15 per cent, a minimum level by which the forest resources can ensure an ecological balance. A sufficient level of afforestation allows better moisture retention, an aspect that is especially important in years with high temperatures. At the same time, it is necessary to expand the area of forested buffer strips. Thus, in order to reduce soil erosion, it is recommended to plant forested buffer strips next to agricultural land.

¹⁴ *Ibidem*, p.3

¹⁵ Lupușor, A., Fala A., Cenușă D., Morcotilo I., Madan S., Republic of Moldova 2020. State of the Country Report, Independent Analytical Center “Expert-Grup”/ Friedrich-Ebert-Stiftung Moldova, Chisinau, 2020, p. 3

ANNEX 1.

Determinants of agricultural production.
The results of the regression estimation based on annual data covering the 2000-2019 period.

Explanatory variables	
Free term	0,089***
of (Previous year's agricultural production)	-0,569***
of [(the annual average temperature)] ²	-0,12***
of (Annual precipitation amount)	0,186*
of (Annual amount of precipitation in the previous year)	0,26**
R ²	0,814
The Durbin-Watson Test	1,723
The Breusch-Pagan Test	4,265

Source: Expert-Grup calculations

Note: of – difference of natural logarithms;

***/**/* - the variable is significant for a confidence level of 1/5/10 per cent

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ENSURING RESILIENCE OF AGRICULTURE TO CLIMATE CHANGE



Climatic conditions are affecting in a significant way the agricultural sector. The severe droughts affecting the entire territory of the country have intensified. In the last two decades, the Republic of Moldova has faced five particularly severe droughts (with high temperatures and a low level of precipitation), which have led to a contraction of the agricultural sector by at least 10 per cent. Thus, the agricultural production decreased by 14 per cent in 2003, by 23 per cent in 2007, by 22 per cent in 2012 and by 13 per cent in 2015. A contraction of the agricultural sector is also expected in 2020, due to unfavourable weather conditions. In the first nine months of 2020, the agricultural production has decreased by $\frac{1}{4}$ compared to the same period of the previous year.



The low degree of adaptation to climate change requires abandoning of the “small steps” strategy by Republic of Moldova in the field of solving environmental problems. Even without access to external resources, the state has internal resources to implement large projects and could at least double the amount of allocations to promote environmental policies. This is possible by increasing the capacity of public institutions in assimilating the budgetary sources allocated for environmental protection. In this context, reforms are needed that would strengthen the state institutions responsible for implementing environmental policies.



In order to increase the resilience of agriculture to climate change, there is need for a number of measures to restore the natural resources. In the medium term (3-5 years), the degree of afforestation of the country should be extended to 15 per cent, a minimum level by which the forest resources can ensure an ecological balance. And in order to reduce the water deficit, the following actions are necessary: investments in infrastructure to reduce water transport losses; restoration and increase of the number of treatment plants to ensure the return of a large volume of water used in production and consumption; restoration and protection of the internal river basin (rivers, streams and lakes).

Further information on the topic can be found here:
www.fes-moldova.org